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Diesel Railway Traction

Foolproof Diesels

THE way in which a steam engine will stand up to rough handling is a byword in the railway world, but it appears as if the diesel locomotive is little inferior in this respect so far as shunting is concerned. During recent months we have had the privilege of spending many hours on the footplate of a variety of diesel vehicles, and have been considerably impressed with the way in which certain units are mishandled with apparent impunity. For instance, on a certain diesel-mechanical locomotive with a three-speed gearbox, the driver was starting loads up to 280 tons on second gear, and did not hesitate to start in *third* gear with one or two wagons. Nor was he disposed to take notice of warnings as to the deleterious effect which this procedure would have on the locomotive as a whole. Such abuses are not uncommon, even when the most careful attention is given to the training of the drivers, and they provide an indication to designers and manufacturers of the thought they must give to making the whole unit as foolproof as possible. The controls, of course, should be as simple as it is possible to make them, but even the simplest operation will not prevent abuse, and the engine and transmission constituents must be of rugged construction to withstand the effects of the human element.

Diesel Traction in the Antipodes

IT is curious that with conditions so suitable for the operation of internal-combustion railway vehicles as exist in Australasia, no diesel-engined unit has been put on the rails until two or three months ago. Projects for locomotives of 1,000 b.h.p. and over have been put forward at various intervals since 1912, principally in connection with the Trans-Australian and Central Australian Railways, but the first practical application of the oil engine has been in a light railcar unit. Development along railcar lines is now proceeding, although not at a very rapid rate, in South Australia, New South Wales, and Queensland, and at least one mining company in the Broken Hill district has been interested in the question of replacing steam engines by diesel locomotives. So far as comparative working costs of diesel and steam units are concerned the former should show a large saving, for the problem of bad water is serious in many parts of the continent, especially in South Australia. Hitherto there appears to have been a fear that the diesel vehicle would be much more unreliable and more costly to work than a petrol-engined car, of which large numbers are at work in New South Wales, South Australia, and Queensland, but this idea appears to have been based on the idea of converting a petrol car, and it is much more difficult to make a satisfactory conversion than to start with a new oil-engined car. Nevertheless, the railways now appear to be impressed with the performance of hundreds of diesel cars in Europe, and in his annual report for the year 1933-34 Mr. C. B. Anderson, Commissioner of Railways for South Australia, states that the efficiency and economy of the diesel power unit in the railcar field is definitely established, and that for an organisation starting out to equip itself with a new fleet of transport units, the problem is a simple one; the Commissioner recognises, however, that the economics of the question are slightly more complicated when petrol cars which are still capable of doing work—albeit at a higher cost—must be scrapped.

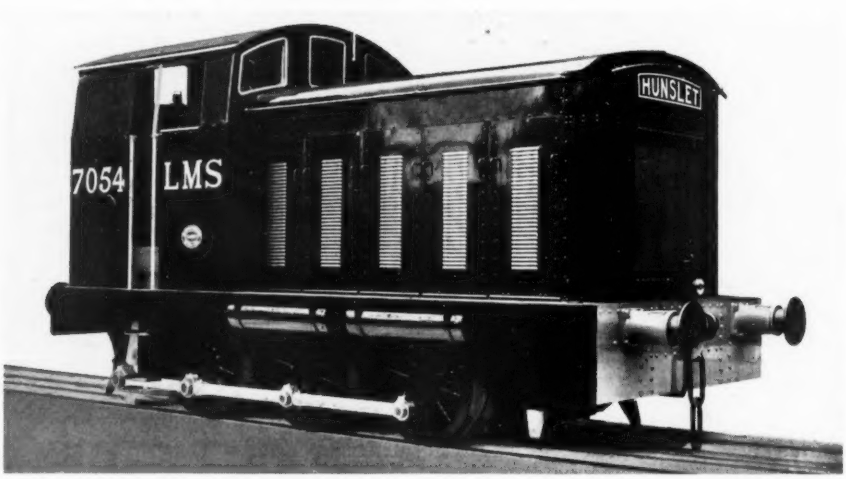
Fractures of Water-Cooled Piston Rods

WITH a view to obtaining a clearer insight into the mechanism of corrosion-fatigue fractures in the water-cooled piston rods of diesel engines, three German engineers, Dr.-Ing. K. Daeves, Dir. E. Kamp, and Dr.-Ing. K. Holthaus, recently subjected to complete examination a corroded but unbroken piston rod taken from a double-acting diesel after 18,000 hr. of service. Mechanically, chemically, and in its microstructure, the steel itself showed no irregularity, but the surface of the bore was coated with a closely adherent scale from $\frac{1}{32}$ to $\frac{1}{16}$ in. in thickness near the screwed end, and thinner towards the piston. Analysis showed that over 80 per cent. of this scale consisted of iron oxides, the remainder being salts from the cooling water. Etching the rod with acid revealed the existence of deep grooves, generally in pairs, in the part of the rod outside the stuffing box. These grooves were perpendicular to the axis of the rod, but confined to one side of the bore, thus excluding the possibility of their being caused by machining. In addition there were many smaller grooves, closer together and not all on one side, in the conical part at the screwed end. The threaded part itself showed slight pitting.

Microscopic examination of the deep one-sided grooves leaves no doubt that they are caused by corrosion and that, once started, they will deepen until the rod breaks by notch effect and fatigue in the reduced section of metal. The reason for this particular form of corrosive attack lies in the fact that the bore is protected against corrosion so long as the layer of rust and salts is thin and flexible. As the covering becomes thicker, however, due to the continued deposition of scale from the water, it becomes unable to follow the elastic deformation of the piston rod, and ultimately cracks along the lines of maximum stress. These are the lines of maximum buckling stress which, for a given engine and piston, always lie on one side of the rod. Directly water gains access to the steel through such a crack local grooving commences, the rate of corrosion being accelerated by galvanic action between the rust and the iron. Similar cracking followed by local grooving is liable to occur in any rust-resisting lining tube or covering unless the stress therein is sufficiently low. Oil-cooling, of course, eliminates the possibility of corrosion. In view of the fact that the fatigue strength of almost all steels lies within or below the range $6\frac{1}{2}$ to $12\frac{1}{2}$ tons per sq. in. where corrosion and notch effect are concerned, the high static tensile strength of heat-treated alloy steels imparts no immunity from breakages of the type considered.

ANOTHER SIX-COUPLED SHUNTER FOR THE L.M.S.R.

Fourth Hunslet machine constructed for this railway is of greater power and weight than the earlier units



THE last of the four diesel-mechanical shunting locomotives ordered some 18 months ago by the L.M.S.R. from the Hunslet Engine Co. Ltd. has now been delivered and accepted, and is working in the Hunslet goods yard at Leeds. The L.M.S.R. now have actually in operation seven diesel shunting locomotives, and another two are completed. In general layout and design the latest unit is not unlike the previous locomotives by the same builders, but the slightly greater size and inward slope of the cab sides give an improved appearance. Coincident with the delivery of this Hunslet product, the L.M.S.R. renumbered its diesel stock; previously the numbers commenced at 7401, but now the initial number is 7051, which is allocated to the first Hunslet locomotive, and the machine under consideration is No. 7054. The black painting and gold lettering are in the same style and position as before.

As may be seen from the accompanying diagram and illustrations, the engine is located beneath the bonnet, and the torque is taken through a Vulcan-Sinclair hydraulic coupling and a Humfrey-Sandberg free-wheel to a three-speed gearbox located beneath the cab, from which the drive is taken to the wheels through a jackshaft and rods. The cab is of exceptionally roomy proportions and is fitted with a bench for shunters, a provision which has been extended to the earlier locomotives.

A six-cylinder Paxman engine forms the power unit and develops 180 to 200 b.h.p. at 900 r.p.m. in cylinders $6\frac{1}{2}$ in. by 10 in. It idles very quietly and steadily at 300-320 r.p.m. Fuel injection is effected on the direct system through CAV-Bosch pump elements and nozzles at a pressure of 2,000-2,200 lb. per sq. in.; the compression pressure is about 450 lb. per sq. in., and the maximum gas pressure approximately 730 lb. per sq. in.

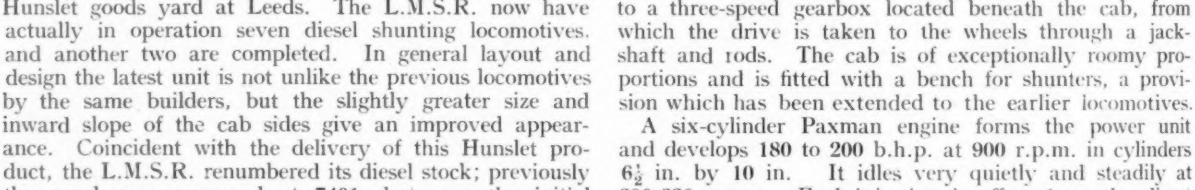


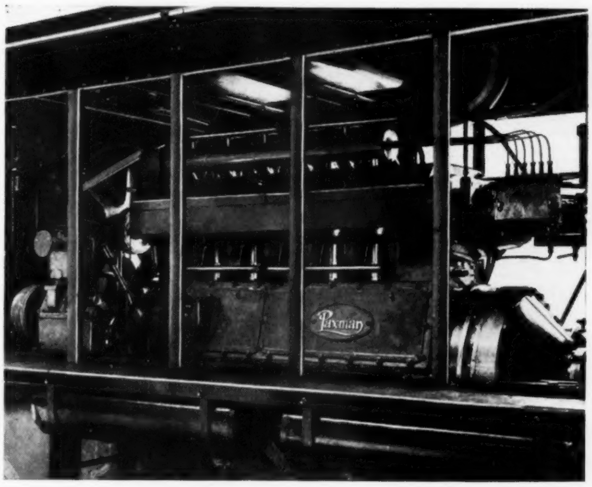
Diagram of 30-ton 200 b.h.p. Hunslet locomotive with Paxman engine

One of the most notable features of the engine is that the framing and crankcase is of the welded steel type to Stevens' patents, and the illustrations at the bottom of this page show the ensemble to be of light yet rigid design. The whole of the stresses due to the gas pressure are taken direct from the cylinder head right down to the seating of the crankshaft bearings in continuous steel plates without any load being imposed on the welding. The construction is simple and allows of easy access to the moving parts when the side covers are removed, and, finally, the weight is only 40 per cent. that of a cast iron structure of equivalent strength.

Two sets of camshafts are incorporated and are located one on each side of the cylinder heads. They are chain driven from the flywheel end of the one-piece crankshaft. The governor control is operated in conjunction with the lubricating oil circuit, so that if the pressure in the latter should fail, the governor functions automatically, and the engine can be run only at idling speed. The cooling water and lubricating oil are cooled in a sectional Reliance gilled-tube radiator mounted on the front of the locomotive, and starting is accomplished by a Scott petrol engine.

From the crankshaft the drive is led through a Vulcan-Sinclair fluid coupling of the traction type, with an anti-drag baffle, as described and illustrated in the issue of this Supplement for November 2. Immediately behind the coupling on the driving shaft is placed the rocking brake, which holds the shaft against the drag of the coupling while the gears are engaged; the rocking action is necessary in order to disengage the gears after the locomotive has been brought to rest. A Humfrey-Sandberg freewheeling clutch is also fitted on the driving shaft, between the fluid coupling and the gearbox; it assists in giving a smooth pick-up and forms a compact overload protection device.

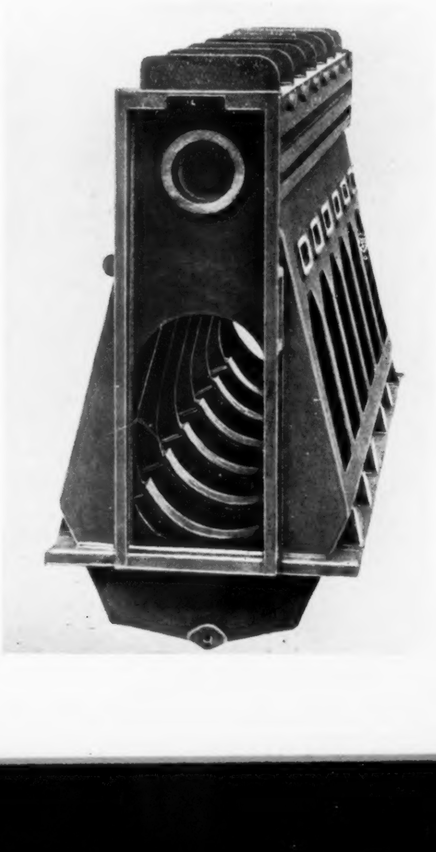
Contrary to what obtains in the previous two Hunslet locomotives, a three-speed gearbox is fitted and the maximum road speed is almost 15 m.p.h. compared with 10 m.p.h. With the engine running at 900 r.p.m., the three gear steps give speeds of 4, 8, and 13 m.p.h. with corresponding tractive efforts of 14,400, 7,200, and 4,400 lb.



Installation of 200 b.h.p. Paxman diesel engine and Vulcan-Sinclair hydraulic coupling in L.M.S.R. shunting locomotive

When visiting this locomotive recently we found the engine running at 950 r.p.m. and the road speeds were thus increased slightly. The gearbox forms a very rigid stay for the locomotive frames, and the constant-mesh gears and gear-changing mechanism are of the Hunslet patent type, and are exceptionally easy to operate. Braking is on the hand and Westinghouse straight air systems.

On the occasion of our visit to Leeds, the locomotive was working in 16 hr. service, in which period it covered approximately 29 miles at a fuel consumption of 26 gal. At the beginning of this month the locomotive had covered 635 miles in shunting work, equivalent to about 350 hr. The extra 4-5 tons weight compared with the earlier machines seemed to be a decided advantage, judging from the way the locomotive stood up to the shocks of heavy shunting, and, of course, it is also of value in permitting a higher tractive effort to be developed.



Two views of the steel framing of Paxman six-cylinder four-stroke 200 b.h.p. diesel engine welded up on the Stevens principle. The stresses resulting from the gas pressure are taken straight down the vertical steel plates and are kept away from the welds

DIESEL TRACTION EXPERIENCE IN ARGENTINA

ENCOURAGING statements as to the service obtained from the diesel-electric units on the Buenos Ayres Great Southern Railway were made by Sir Follett Holt at the recent annual meeting of that company. In reviewing the future, the Chairman said that the results had been so valuable that it would no doubt pay the company to replace all its steam locomotives with diesel engines over a period of years; it was therefore unlikely that the Great Southern would again ship a steam locomotive to Argentina. The company was considering the construction of a 50-mile branch from Dolores to Ajo, and, when built, this line would probably be the first to be laid out definitely for diesel traction, and would have no running sheds or watering stations.

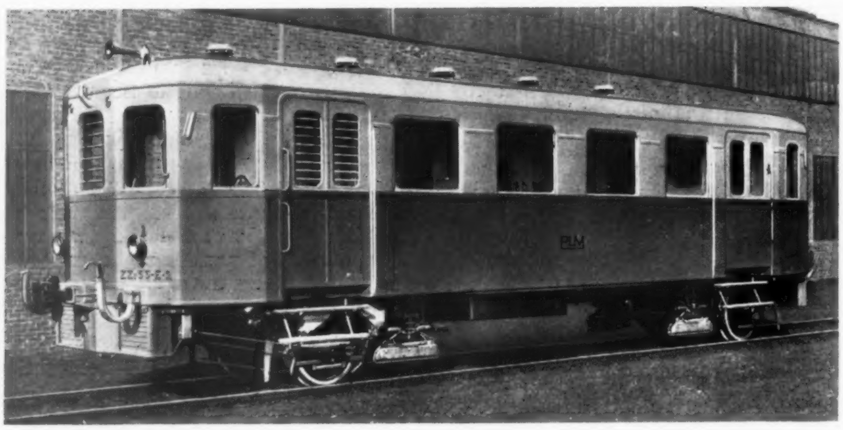
Contained in the General Manager's report for the year ending June 30, 1934, are some interesting figures as to the mileage and duties performed by the two 1,200 b.h.p. (Nos. U.E.1 and U.E.2) and 1,700 b.h.p. (Nos. U.E. 3 to 5) diesel-electric mobile power houses. The smaller units were acquired in 1929 and work five-coach trains, whereas the three larger units were set to work in June-July, 1933, and work eight-coach trains. On October 20, 1933, a new local timetable was put into force with 22 trains on an accelerated 16-hr. service run by one of the new units, and the service continues to be performed satisfactorily. A second unit was put on a fast schedule which, in case of necessity, could be worked by steam locomotive, and a third was diagrammed on an ordinary steam schedule. Up to February, 1934, the three units ran daily 53 local trains with a total kilometrage of 1,152. The time taken to turn these units at terminals varied from 5 to 10 min., compared with the 35 to 45 min. of steam locomotives.

Up to the end of June, 1934, the five power houses had run the following total distances:—

	km.		km.
U.E. 1	220,002	U.E. 4	123,245
U.E. 2	210,381	U.E. 5	63,855
U.E. 3	119,853	(Out of service since February 7, 1934, with broken crankshaft)	

The 1,700 b.h.p. locomotive put into main-line traffic on December 4, 1933, has given superior service to any steam engine. It has been working the Bahia Blanca express out to Olavarria, and, after a 15 min. stop to change drivers, working another express back to Buenos Aires, covering 680 km. in its 16-hr. trip. It has also been tried on 3,000-ton goods trains, and has covered a total of 91,674 km. to June 30, 1934.

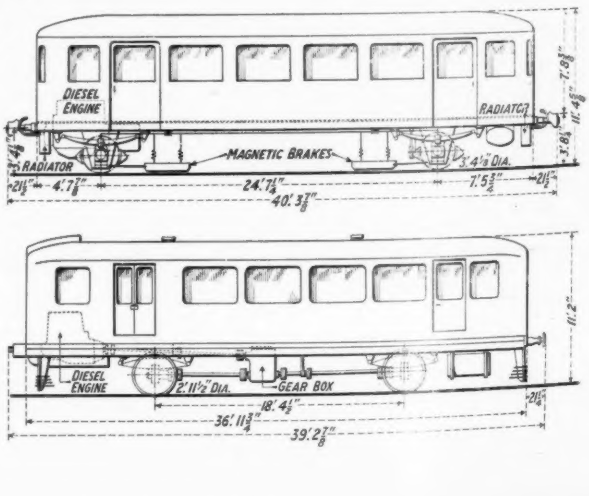
SMALL DIESEL-ELECTRIC RAILCAR IN FRANCE



Left: General view of four-wheeled 140 b.h.p. diesel-electric railcar now running on the P.L.M. Railway

Below: Diagrams of four-wheeled 140 b.h.p. diesel-electric and diesel-mechanical railcars of the P.L.M. Railway. The two vehicles illustrated were designed to be identical as far as was possible, in order to test the merits of the two transmission systems for small outputs

ONE of the last-delivered of the 22 diesel railcars ordered by the P.L.M. Railway in 1932 was a 140 b.h.p. Saurer-engined car with electric transmission. The builder was the Cie. Française de Matériel de Chemin de Fer, which at the same time constructed a similar car with mechanical transmission so that both types of drive could be tested; the two cars are shown in the diagrams in the next column. The electrical equipment was supplied by the Ateliers de Construcion Oerlikon, and comprises a direct-coupled d.c. generator; a single nose-suspended traction motor at the other end of the car from the power unit; and a simple type of control. The complete electrical equipment weighs only 1·8 tons. Emergency braking is provided in the form of the Oerlikon electro-magnetic rail brake with four shoes, and normal stops are made by air and hand brakes. The seating capacity is 50, and there is a small luggage compartment; the maximum normal speed is 60 m.p.h. Both vehicles are working on the Laroche-Clamecy section.



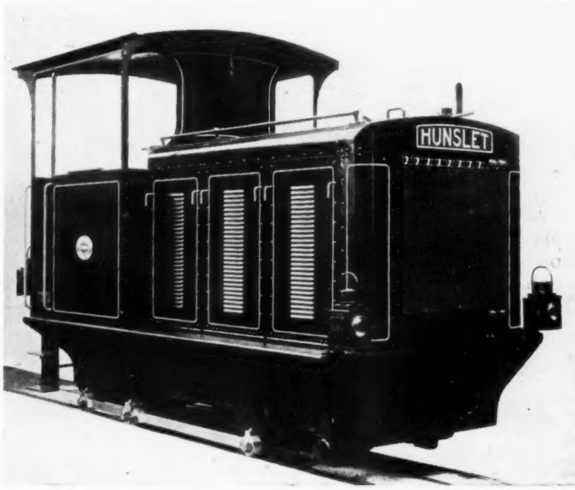
DIESEL-MECHANICAL LOCOMOTIVE FOR EGYPT

Hunslet production for light mixed work

FOR the operation of light passenger and goods trains on its network of 2 ft. 6 in.-gauge lines round the Nile delta, the Egyptian Delta Light Railways has just acquired a small four-wheeled diesel-mechanical locomotive. Built by the Hunslet Engine Co. Ltd. to the requirements of the consulting engineers, Messrs. Rendel, Palmer & Tritton, the locomotive is to a design which enables it to compete on terms of equal wheelbase, axle load, and power, with the Sentinel geared steam locomotives already at work.

The power unit is a six-cylinder four-stroke McLaren engine developing 112/120 b.h.p. at 1,000 r.p.m., and fitted with C.A.V.-Bosch fuel injection equipment. The transmission consists of a Vulcan-Sinclair traction-type hydraulic coupling; a three-speed constant-mesh gearbox with the Hunslet patent pre-selective automatic gear change; and a jackshaft and rods for the final drive. By the combination of this gear-changing arrangement with the hydraulic coupling an almost instantaneous change of gear is possible, and this without any complicated mechanism.

As regards auxiliaries, normal Hunslet practice has been followed as far as possible. Starting of the main engine



120 *b.h.p. diesel locomotive for the Egyptian Delta Light Railways*

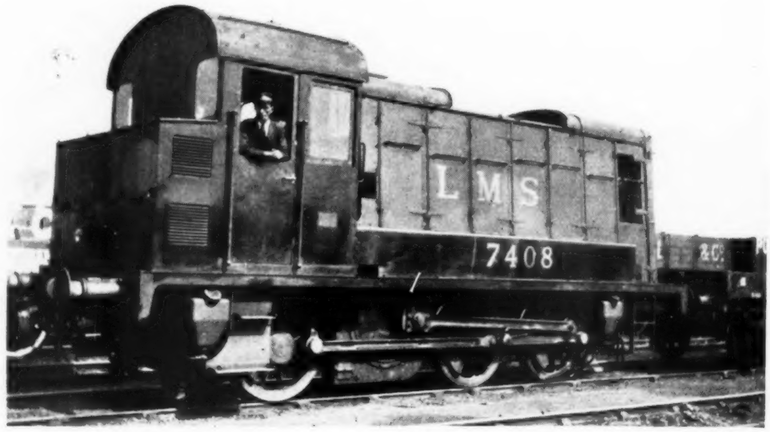
is carried out by a Scott petrol engine and Bendix gear. The circulating water is cooled in a large Serck radiator located at the front of the bonnet, and in view of the high ambient temperature certain sections of this radiator are devoted to the cooling of the engine lubricating oil, a provision which is by no means usual in machines of this size.

LEST ONE GOOD CUSTOM SHOULD CORRUPT THE WORLD. The 900 b.h.p. six-car articulated Union Pacific diesel-electric train being hauled by a New York Central electric locomotive over the Park Avenue tracks into the Grand Central terminal at the end of its run from Los Angeles. No power unit emitting smoke is allowed to work in the Grand Central station

DIESEL VEHICLE PERFORMANCE

*II—L.M.S.R. 250 b.h.p. diesel-electric shunting locomotive**

ALTHOUGH over 90 per cent. of the diesel locomotives in the world are engaged in shunting service, there is as yet no finality in design, either as it affects engine, transmission, or mechanical portion. Nevertheless, a high degree of success has been obtained with diesel units employed in heavy yard service, and on certain railways it has been found possible to make an almost direct comparison between locomotives of different construction.



250 b.h.p. Armstrong-Whitworth diesel-electric shunting locomotive on the L.M.S.R.

Such a comparison is now being made on the L.M.S.R. where electrical and mechanical transmissions are being put through their paces to see if one has any decided advantage over the other in special or in general service. That geared drive has not yet been developed sufficiently to permit of its application to shunting locomotives of high starting tractive effort has been recognised on the L.M.S.R., where the machines with mechanical transmission do not exceed 180 b.h.p., whereas electric transmission is used up to 250 b.h.p., and units giving an output of 250 to 300 b.h.p. are contemplated. The transmission of these larger machines has not been settled.

Some time ago there was described in these columns the type of work done by one of the L.M.S.R. diesel-mechanical shunters, and by the courtesy of that company's engineers we had the opportunity recently of observing the work performed by the 250 b.h.p. Armstrong-Whitworth diesel-electric locomotive No. 7408 (now No. 7058) in Brent sidings, near Willesden, and some of the particulars which we obtained are given in the accompanying notes and diagram. This locomotive was delivered to the railway in February, 1934, and has undergone tests at various marshalling yards before going to Brent. It is of the six-coupled type, driven through a jackshaft and rods from a single traction motor. The engine is of Armstrong-Sulzer make, and develops a rated output of 250 b.h.p. at 775 r.p.m. in six cylinders having a bore of 220 mm. (8·7 in.) and a stroke of 280 mm. (11 in.). The engine, generator, force-ventilated traction motor and certain of the auxiliaries are arranged within the casing in front of the cab. The control is completely automatic and limits the current at starting, keeps the engine output at full load on the last controller notches, and prevents the overloading of the engine and generator. A foot-operated dead-man device with a time-relay is incorporated, and braking is effected by a non-automatic air system with a supplementary hand brake. Apart from the dimensions given on the accompanying drawing, the main particulars are: weight in w.o. 40 tons; max. axle load 13·5 tons; starting tractive effort 24,000 lb.; factor of adhesion 3·74.

The locomotive is engaged in 24-hr. service for six days a week, the schedule calling for the locomotive to be available for operation in the sidings from 2.0 a.m. on Monday to 6.0 a.m. on Sunday. It is handled by three shifts of men in 24 hr., and covers an average mileage of 40 a day. This figure, taken in conjunction with the first of the accompanying diagrams, shows not only the low maximum speed, but the frequency of the stops, even in the heaviest service. Taken over the whole 24 hr. the mean speed is only 1·66 m.p.h., and in over three hours on the footplate we did not record a speed in excess of 10 m.p.h., and even that rate was attained but rarely. Most of the movements did not extend to a distance of 200 yd.

This performance draws attention to the question of what is the best value for the top speed of a diesel shunter. More than one of the L.M.S.R. gear-transmission units are limited to a maximum of 10 m.p.h., but while this is quite sufficient for the majority of requirements it means that the locomotive is confined to a certain class of yard and cannot be used indiscriminately over the whole system. For general shunting use it is probable that a maximum speed of 15-20 m.p.h. is as high as is necessary.

The fuel consumption of the Armstrong-Whitworth shunter on the work on which it is engaged at Brent averages 60 gal. in 24 hr. If it is assumed that the specific gravity of the fuel is 0·87, and the consumption is 0·43 lb. per b.h.p. hour, then the load factor is about 20 per cent., a figure which is by no means low when referred to general yard service. It is the practice at Brent to shut down the engine for stops which it is known will be of, say, five minutes duration or more, such as those occa-

* No. I appeared in the issue for April 20, 1934.

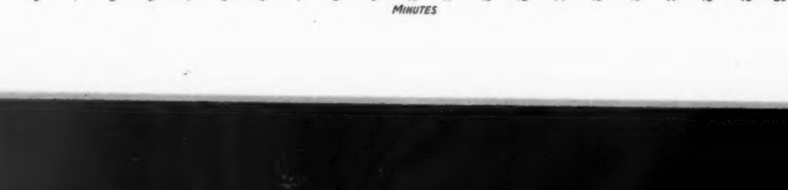
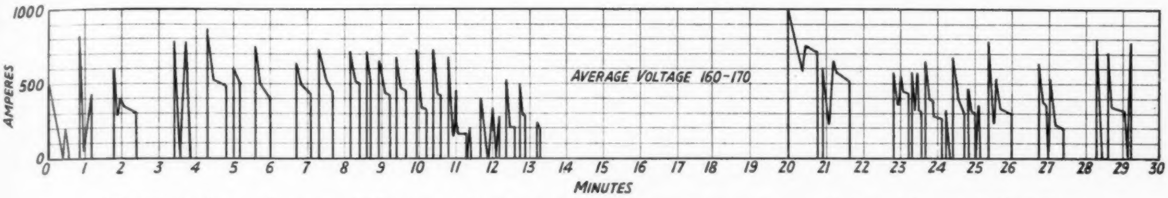


Diagram of normal locomotive movements while engaged in marshalling work at Brent sidings



Electrical demands upon 250 b.h.p. diesel-electric shunting locomotive at Brent sidings, L.M.S.R.

sions when shunting must be suspended to allow a goods train to get out on to the main line. On the Armstrong locomotive the starting is electric, the main generator acting as a motor.

Loads of over 30 wagons—say 500 tons—are comparatively rarely handled, but a maximum of 65 wagons, or about 1,000 tons, has been hauled at Brent sidings. With a trailing load of 32 wagons totalling 310 tons, we noted an acceleration from rest to 6·0 m.p.h. in 20 sec. without undue snatching at the couplings; and when pushing 14 wagons weighing 195 tons, from rest to 5·0 m.p.h. in 10 sec. In the latter performance the acceleration rate was 0·5 m.p.h. per sec., and at the moment when 5·0 m.p.h. was reached the rail effort must have been approximately 10,500 lb., equivalent to a rail horsepower of 140, and an engine b.h.p. of slightly over 200. In the former case, however, the rail tractive effort must have been about 11,900 lb. and the momentary rail horsepower 190, which would mean that the engine was developing the full rated output of 250 b.h.p.

The controls of the diesel-electric locomotive are very simple, and while the arrangement at each side was convenient, we felt that the cab layout as a whole left something to be desired. The cab is hardly big enough, most of the interior being taken up with a large control desk. On a warm day the interior forms a hot-air pocket, even with all the windows open, for the silencer is fixed to the outside of the front weatherboard and succeeds in transmitting a good deal of its heat to the inside. Again, the cab heaters are placed one exactly in front of each driving position, and heat the legs thoroughly without ensuring that the whole of the cab is at a comfortable temperature in winter. Fortunately, these matters can be rectified without much expense in future designs, and this remark also applies to the ventilation of the engine compartment. In hot weather it has been found desirable to work with at least one of the top covers open, as shown in one of the accompanying illustrations.

On the occasion of our visit the lubricating oil temperature averaged 60 to 62° C., and fell to a minimum of 55° C. after a stop of 12 to 15 min. Continuous shunting for half an hour without any stop exceeding 50 sec. brought the oil temperature up to 64° C. The cooling water temperature kept fairly steadily to 70° C. To assist in keeping the lubricating oil clean, the filter in the engine sump is given a turn every four hours.

This is the first diesel locomotive we have seen in this country which carries sufficient fuel oil for a week's shunting, a feature which is of advantage to those responsible for traffic operations, since no long breaks into the day's work are required for refuelling. Main tanks are mounted on the bedplate on each side of the locomotive, and these are filled up each week-end. There is a feed tank in the roof of the cab which is filled up from the main tanks by a semi-rotary pump by the drivers at convenient intervals.

We were impressed with the smoothness of starting given by the electric transmission, and although snatching of the couplings was not eliminated, it was reduced to an extent which must be resulting in a decreased number of coupling breakages. The noise on the footplate was little different from that on any other diesel-electric or diesel-mechanical locomotive, and the locomotive was very easy and clean to handle, without approaching the standard set up by certain salesmen who believe that a diesel driver goes to work wearing his Sunday suit.

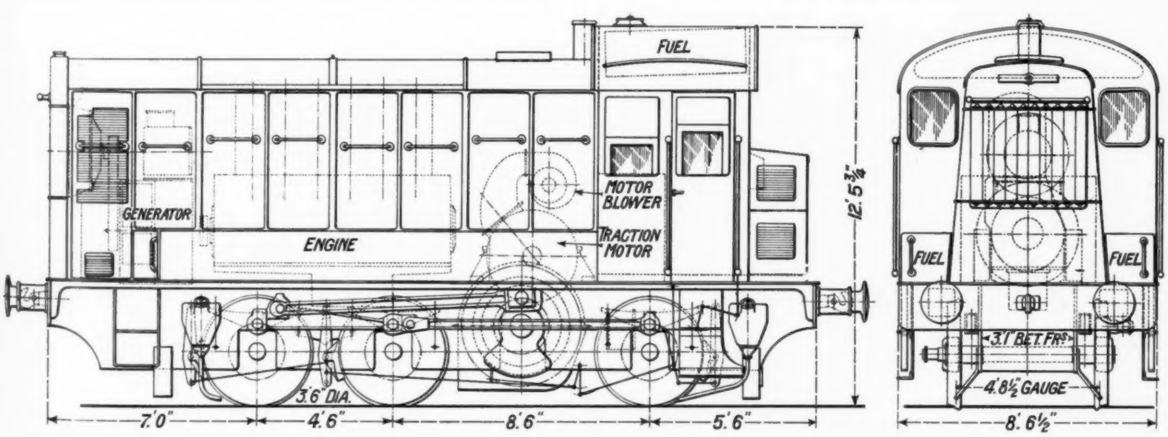


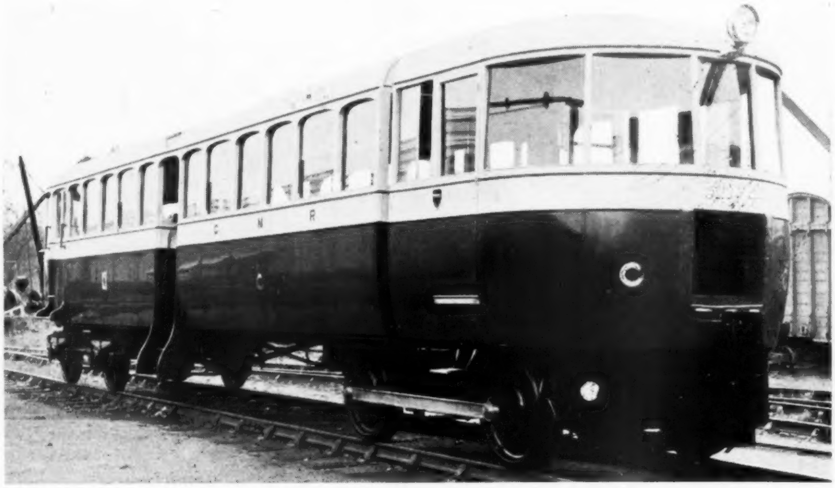
Diagram of Armstrong-Sulzer engined shunting locomotive

Modern Transportation Diesels.—We have just seen described as a "new high-speed diesel railcar" a vehicle with a top speed of only 56 m.p.h., which was first described in this Supplement exactly 20 months ago. We are glad to see that, surrounded by the spate of diesel railway vehicles produced during the last eighteen months, there are still some in whom the spirit of discovery is not dead.

American Diesel Inquiry.—The Lehigh Valley Railroad is inquiring for three diesel-electric shunting locomotives of 600 to 800 b.h.p. These are in addition to the 11 units acquired during the course of the present year.

NEW BROAD-GAUGE DIESEL RAILCAR IN IRELAND

Double-bogie vehicle introduced on branch line near the Atlantic coast



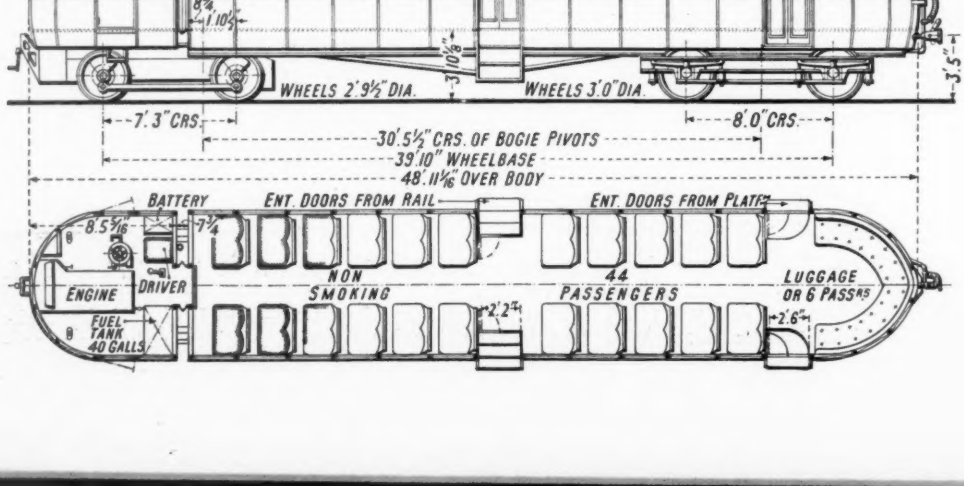
New Gardner-engined broad-gauge railcar on the Great Northern Railway of Ireland

AFTER having had experience with two diesel railcars (see THE RAILWAY GAZETTE, July 15, 1932) for over two years, the Great Northern Railway of Ireland, under the direction of Mr. George B. Howden, Chief Engineer, has just put into service a third vehicle, which has similar features of construction to the three cars working on the lines of the County Donegal Railways, the bodies of all of which were built at the Dundalk works of the G.N.R. (I.).

In the latest railcar, designated C in the railway company's list, the engine, gearbox, and driving cab are mounted on the driving bogie, to which the remainder of the car is attached by an articulated pivot. The complete power bogie was built by Walker Bros. (Wigan) Limited, and the car body, underframe, and trailing bogie at Dundalk. The design as a whole was evolved on the basis of light weight without sacrifice of strength, and the actual tare weight of 14·75 tons represents 660 lb. per seat, 6·5 b.h.p. per ton of tare, and 1·92 b.h.p. per seat. The underframe, although almost 40 ft. long, weighs only 1½ tons.

The engine is of the Gardner 6LW type developing a rated output of 96 b.h.p. at 1,600 r.p.m. The top of the engine projects into the driving cabin and is covered by a sheet steel casing with removable side doors. The clutch is of the ordinary multiple friction type, and with normal engine revs. the four-speed gearbox gives road speeds of 10·2, 16·5, 27·8, and 45 m.p.h. in the forward direction; as the car runs in one direction only, the reverse gear gives only one speed for backward travel, viz., 8·2 m.p.h. The drive from the gearbox to the inner axle of the driving bogie is by a cardan shaft and worm gear, and the drive is transmitted thence to the leading axle by coupling rods. The engine is started electrically, but a detachable starting handle is provided for use in emergency. The lead-type starting battery, which is also used for the coach lighting equipment, was supplied by C.A.V.-Bosch Limited and is of 220 amp. hr. capacity. A VS2 exhauster by the Vacuum Brake Co. Ltd. is mounted on the driving bogie and is driven from the engine by triple V belts. A fan-cooled gilled-tube radiator by the Spiral Tube & Components Co. Ltd. is mounted on the front of the vehicle.

Bow ends have been fitted to the car, and at the rear this space is used for light luggage and mails as well as for six passengers, but since the car went into service a certain demand has arisen for space to put bicycles! There are two sets of doors to the car, the set in the centre of the car being used for entrance and exit at rail level, and the rear doors being used at platforms. The front half of



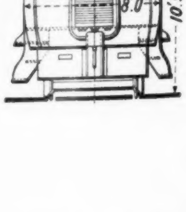
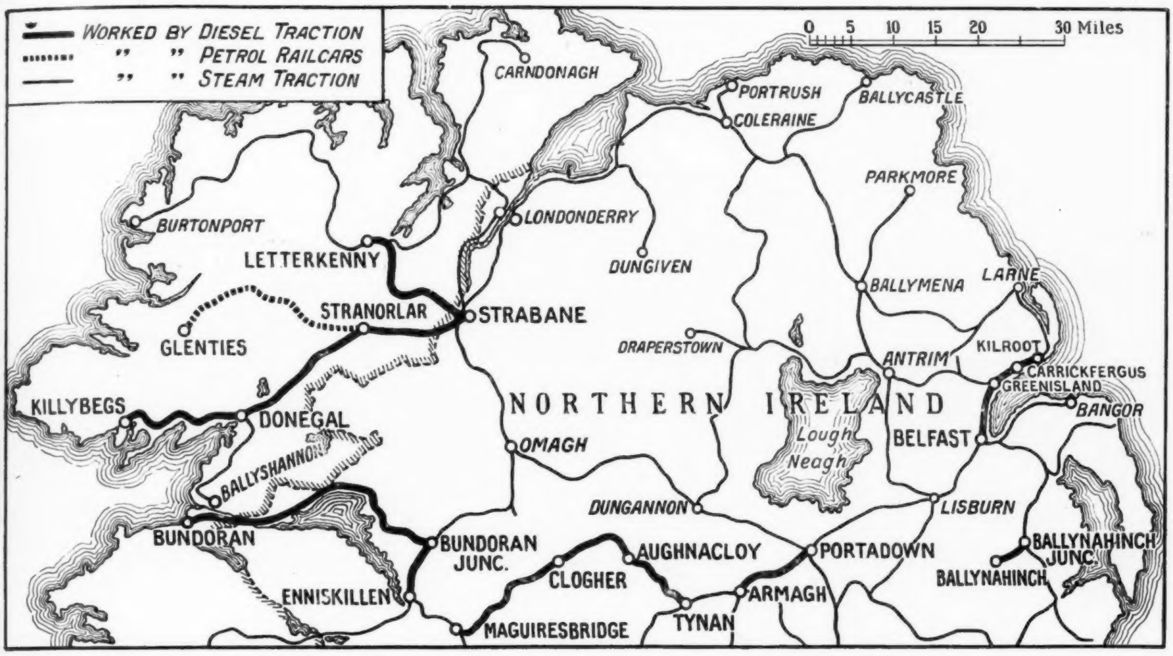


Diagram showing layout of new 95 b.h.p. diesel-mechanical railcar, G.N.R. (I).



Map showing lines in the north of Ireland over which diesel services are provided

the car is non-smoking. The seats were supplied by Laycock Engineering Co. Ltd. and are of the tubular frame type comfortably upholstered in moquette. The floor is covered with Ruberoid, and the passenger compartments are heated by circulating the engine cooling water through Burlingham heaters located beneath the seats. Down each side of the car are four Young half-drop windows, and in the roof are two Colt air extractors. In addition to the roof lamps there are five lights down each side of the car, and the brackets for these and for the luggage racks were cast in aluminium at Dundalk works.

The underframe supports the car floor and body through wooden cross joists, and thus follows road vehicle practice. The various members of the underframe are attached to each other by riveted joints. The car is not intended for the regular haulage of trailers, but a simple type of central buffing and draw gear is fitted at the rear end so that a couple of cattle wagons or horse boxes can be hauled if required. At the front end is a rigid central buffing plate which acts as a protector and can be used for attachment in case of emergency. The trailing bogie is built up from light channel sections and the wagon-type wheels run in Hoffmann roller bearings. The wheels of the front bogie are of the disc type, suitably balanced, and the axles are carried in Timken roller bearings. Automatic vacuum and hand screw brakes operate blocks on all wheels, and foot-operated sanding gear is fitted to the leading wheels. When empty, the front bogie carries a load of 8·85 tons and the trailing bogie 5·9 tons, but when the car is fully laden the respective weights are 10·25 and 7·9 tons; the maximum axle load is about $5\frac{1}{2}$ tons.

The car is now operating over the Enniskillen-Bundoran

Interior of 95 b.h.p. 50-seater diesel - mechanical railcar now at work on the Enniskillen to Bundoran line of the Great Northern Railway of Ireland. Although the car runs on the 5 ft. 3 in. gauge it is no wider than standard gauge stock

line and is making a mileage of 160 a day for six days a week with a fuel consumption averaging more than 12 m.p.g. Leaving Bundoran at 6.25 a.m., the car reaches Enniskillen at 8.5 a.m. and leaves again at 8.50 a.m., reaching Bundoran at 10.35 a.m. In the evening it departs from Bundoran at 5.40 p.m., reaches Enniskillen at 7.0 p.m., leaves at 7.30 p.m. and reaches Bundoran at 8.50 p.m. The line has long grades of 1 in 100 and a short length at 1 in 76; curves as sharp as 300 ft. radius are encountered near Enniskillen and are negotiated without trouble. On a recent visit to this line we timed the car several times at the maximum rate of 45 m.p.h., both on the level and downhill, and considering the nature of the track on this secondary line the running was remarkably steady. With two empty wagons scaling 14 tons, the car maintained 40 m.p.h. up a 1 in 177 grade, and this represents just about its maximum performance with rated engine output. Starting from rest on a 1 in 130 grade, the car alone covered the first quarter-mile in 35 sec.

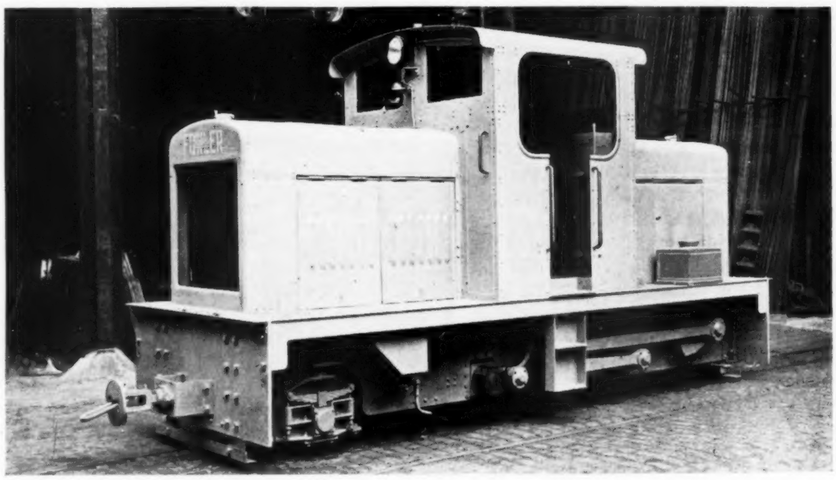
The first car of the G.N.R. (I), designated A, has an A.E.C. 130 b.h.p. engine and mechanical transmission, and from being put into service in July, 1932, until March 31, 1934, it covered a mileage of 56,987. The second vehicle, car B, is driven by a 130 b.h.p. Gleniffer engine with electric transmission; it went into service in October, 1932, and on March 31, 1934, had a mileage of 54,398 to its credit. The operating cost taken over both cars averaged 3·85d. per mile, including general overhauling, the total being made up as follows:—

Wages	1·74d. per mile
Fuel	0·70d. ,, ,,
Lub. oil. and sundries	0·42d. ,, ,,
Running repairs and overhauls.. ..	0·99d. ,, ,,
	3·85d. ,, ,,

The value of spare parts ordered and the cost of repairing damage caused by mishaps, which amounted to £816, is not included in the above figures.

BRITISH DIESEL LOCOMOTIVE FOR SOUTH AFRICA

Small unit with unusual wheel arrangement

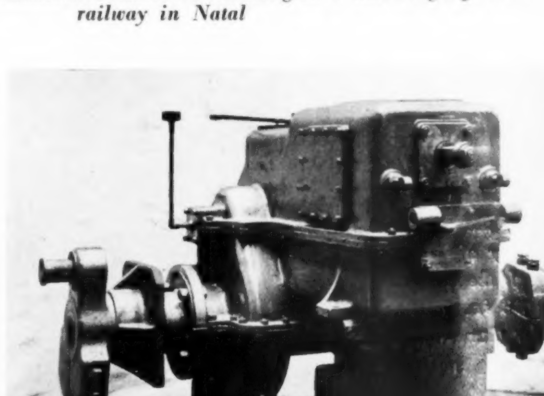


85 b.h.p. Fowler diesel-mechanical locomotive as running on a narrow gauge industrial railway in Natal

AMONG the diesel locomotives recently built by John Fowler & Co. (Leeds) Ltd. for export is one of 85 b.h.p., which is rather unusual among small units in having the 1-B-0 or 2-4-0 wheel arrangement. This machine is now operating over a 2-ft. gauge line in Natal with rails weighing 35 lb. per yd. and curves having a radius of 80 ft.

The four coupled wheels have a diameter of 2 ft. 4 in. and are spread over a base of 4 ft. 9 in.; the total wheelbase is 9 ft. 9 in. and the weight in working order about 17 tons. The engine throttle lever, clutch lever, and Westinghouse air brake handles are duplicated to facilitate operation from either side of the cab. Hand sanding gear is fitted to the outsides of both pairs of coupled wheels.

Motive power is provided by a four-stroke 85 b.h.p. Fowler engine, which, together with the clutch, is mounted in the end of the locomotive opposite to that housing the gearbox, jackshaft, and air brake apparatus. This layout gives an equal distribution of weight on the driving wheels and permits easier access to the constituents than if all the apparatus was grouped together under one bonnet. The gearbox is of the totally enclosed type and, following normal Fowler practice, the final reduction gear is mounted on the jackshaft, that is, on the driven side of the reversing bevels. The gears are machine-cut from heat-treated steel and are mounted on solid splined shafts. The jackshaft drives the wheels through a rod connected to the top eye of a triangular coupling rod and all these rods are fitted with Skefko ball bearings. The fuel tank has a capacity of 45 gal., more than sufficient for a day's hard work.



Gearbox and jackshaft of 2-ft. gauge Fowler diesel-mechanical shunting locomotive

THE THREE-POWER SHUNTING LOCOMOTIVE

WITHOUT attempting a precise estimate of the waste that is at present occurring in obsolete or otherwise unsuitable shunting locomotives in railway and private industrial service, there can be no doubt that the annual total reaches a formidable amount. Correspondingly large savings can be effected by installing new locomotives adapted to the requirements of this service, the distinctive features of which are intermittent operation, with a considerable percentage of idle time, and frequent high peak loads during starting and acceleration. These conditions are well met by the oil-electric-battery or three-power locomotive combining the following advantages: (1) High thermodynamic efficiency of the diesel engine. (2) Immediate readiness for service with no standby expenditure when idle. (3) Freedom from third-rail or overhead line, with ability to run over the same tracks as a steam locomotive. (4) High peak power available by use of diesel-electric generator and battery in parallel, the adhesive weight of the locomotive being sufficient to permit full utilisation of the power thus available. (5) High efficiency and long life of battery in floating or buffer service, compared with alternate charge and discharge as in a plain battery locomotive.

In the three-power locomotive the full capacity of the diesel engine is used whenever possible to supply power directly to the electric traction motors. The locomotive may be idle for anything from 25 to 75 per cent. of the total time in service, and during the idle periods the diesel-electric generator is used as required to restore the battery charge. For short periods, the battery can supply a current many times greater than its continuous-discharge rating (up to about eight times the 5 hr. discharge rate), and this current added to the full-load current of the diesel-electric generator gives a short-time output far higher than that of the engine itself. Also, the ampere-hour efficiency of the battery on rapidly alternating charge and discharge may be anything from 5 to 8 per cent. higher than prolonged charge and discharge. Finally, there is, within reason, no limit to the time an oil-electric-battery locomotive can remain in service, for the repeated increments of charging during idle periods maintain a working charge in the battery at all times.

In the issue of the *Diesel Railway Traction Supplement* for February 23, 1934, we published operating data relating to the oil-electric-battery shunting locomotives of the New York Central Railroad. These locomotives are three-power machines with third rail shoes fitted in addition to the diesel-electric set and battery. Diesel motive power in the N.Y.C. locomotives is provided by Ingersoll-Rand standard 300 b.h.p. engines, and the 240-cell storage battery is of 650 amp. hr. capacity. A combined engine and battery output of 800 b.h.p. is possible for short periods, and the capacity on external power is 1,600 h.p. The wheel arrangement is Bo-Bo, with bogies of 8 ft. 3 in. wheel base and a total wheel base of 34 ft. 1 in.; the total weight of the locomotive is 114 tons.

The particulars given in the article cited concerning the performance of the N.Y.C. locomotives can now be supplemented by data relating to a lighter type of oil-electric battery locomotive, viz. a 58-ton machine with a 180 b.h.p., 900 r.p.m. diesel engine, a 224-cell, 376-amp. hr. battery, and four 165-b.h.p. traction motors. The possibility of operating a total traction motor capacity of 660 h.p. from a 180 b.h.p. prime mover is an indication of the value of the battery. This machine was built by the General Electric Company, Schenectady, in co-operation with the Electric Storage Battery Company, and the Buda Engine Company, primarily for yard shunting purposes, and with particular provision for 24-hr. service as required in many steel plants. The leading dimensions of the locomotive are:—

Wheel arrangement	Bo-Bo.
,, diameter	3 ft. 2 in.
Wheelbase, bogie	6 ft. 8 in.
,, total	24 ft. 8 in.
Weight in working order	58 tons (all adhesive).
Length over couplings	36 ft. 4 in.
Width	10 ft.
Height overall	12 ft. 10 in.

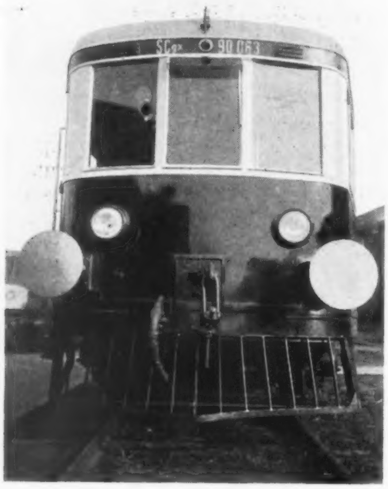
From a report by G. H. Shapter, of the General Electric Company's Transportation Engineering Department, the principal figures from a series of performance tests on this locomotive may be expressed as follows:—

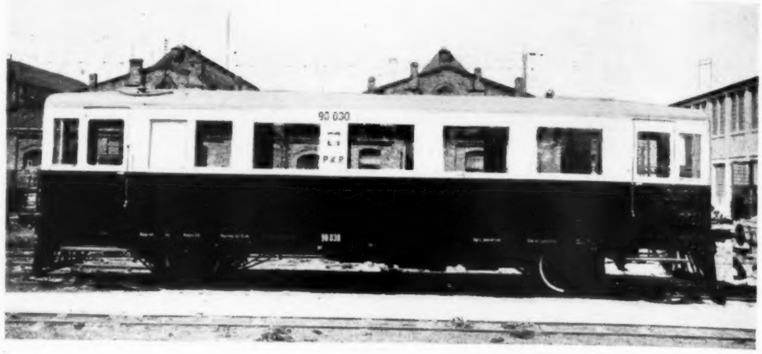
Test	No. 1	No. 2	No. 3
Duration of tests, days	12	10	9
Hours in service, per day	24	12·4	21·4
Engine running, hr. per day ..	22	8·3	20·4
Engine running, per cent. of loco. hours in service	91·5	67·0	95·5
Battery amp.-hr. discharge/amp.-hr. charge (for full period of tests), per cent.	71·5	82·5	88·0
Battery amp.-hr. discharge, per day	261	152·6	295
Battery amp.-hr. discharge, per cent. of battery capacity (376 amp.-hr.)	69·5	40·5	78·5
Generator output, kWh. per day ..	870	306·8	717
Generator output, average kW.* ..	39·5	38·3	35·4
kWh. per gallon (Imp.) of engine fuel oil	9·45	10·6	9·22
Engine lubricating oil, gallon (Imp.) per hr.	0·125	0·03	0·057
Locomotive travel, average miles per hr. in service	3·67	2·4	3·2

* kWh. per hr. of engine running.

As will be seen from these figures, the generator output ranges from 850 to 950 kWh. per 24 hr., while the battery output ranges from 115 to 145 kWh., per 24 hr. and is, in all the cases considered, less than the 165-kWh. capacity of the battery on a 6-hr. discharge. In other words, less than its kWh.-capacity is taken from the battery in 24 hr., and apart from the relatively low duty thus imposed on the cells it is important to note that the output is taken from a battery continuously at or near full charge. The sp. gr. of the acid in the cells at 3 p.m. on each day of the tests averaged 1265 during the No. 1 trials and 1260 during each of the others.

ANOTHER OIL-ELECTRIC-BATTERY LOCOMOTIVE.—The East Erie Commercial Railroad, which looks after the interchange of traffic between the New York Central, Nickel Plate, and Pennsylvania Railroads and the General Electric Company's plant at Erie, has recently acquired an oil-electric-battery locomotive with a Buda 100 b.h,p diesel engine. The main contractor was the International G.E.C., of Schenectady.





Above: Light 100 b.h.p. diesel railcar for branch line work

Left: End vi ew of double-bogie for secondary traffic

Centre: Double-bogie double-engine 200 b.h.p. diesel-mechanical car used for hauling trailers on secondary lines

Bottom: Two types of third class interiors in Polish diesel cars

DIESEL RAILCARS ON THE POLISH STATE RAILWAYS

THE ADOPTION OF DIESEL TRACTION IN POLAND

Double-bogie and four-wheeled cars just set to work are likely to prove harbingers of extensive system of diesel operation

ALTHOUGH numerous petrol-mechanical and petrol-hydraulic standard-gauge railcars have been working in local and branch line traffic on the Polish State Railways for a considerable time, it is only within recent months that diesel traction has been seriously considered. Three trial railcars have been built in Poland for service on secondary lines, and if these are satisfactory it is probable that a much wider application will be found for such units. In the main, Polish lines are not suitable for high speed, and none of the cars now at work have maximum speeds in excess of 85 km.p.h. (53 m.p.h.).

A good deal of the development work of diesel cars in Poland has been in the hands of Lilpop Rau & Loewenstein Ltd., a company which was founded in Warsaw in 1818 by two Englishmen named Evans. The present title dates from 1874. The firm acted as main contractor for the three standard-gauge cars now running, two of which are double-bogie and the third a four-wheeler.

Double-bogie Cars

The first eight-wheeled car is a mechanical-transmission unit powered by two four-cylinder 100 b.h.p. WBLD Saurer engines (built in Poland under licence), which, with their attached Mylius four-speed gearboxes, are mounted below the underframe on rubber insulating blocks. The engine cylinders have a diameter of 110 mm. (4·33 in.) and a stroke of 150 mm. (5·91 in.) and the rated speed is 1,800 r.p.m. The weight per engine is 820 kg. (1,835 lb.), equivalent to 18·35 lb. per b.h.p. One or both engines can be operated from each driving compartment, and the cooling water is circulated through the passenger compartment for heating purposes; an oil-fired boiler is provided to give additional heat in the winter and to prevent the cooling water circuit freezing if the car has to stand for any time.

Channel sections and steel plates welded together are used for the bogie frame structure. The wheels of 920 mm. (36 in.) diameter run in SKF roller bearings and are spread over a base of 2·15 m. (7 ft. 1 in.); the pitch of the bogies is 11·8 m. (38 ft. 10 in.). Air and hand brakes are fitted, and can stop the car on the level from a speed of 85 km.p.h. (53 m.p.h.) in a distance of 220 m. (240 yd.). Dead-man control is incorporated. The car is 17 m. (55 ft. 11 in.) long, 2·9 m. (9 ft. 6 in.) wide, and tares 27·5 metric tons. Standard buffing and draw gear is fitted for the haulage of trailers.

Wide central doors on each side divide the car into two third-class compartments each with 36 seats; there are four folding seats in the central gangway. The interior is veneered in pearwood and the seats are lightly upholstered in blue cloth. The floor is covered with a rubber carpet and the partitions of the two driving cabins are insulated with cork pads. All the windows in the passenger compartment are of the drop type, supported in aluminium frames, and the remainder of the fittings, including door locks, ash holders, and side tables are chromium-plated.

The second double-bogie car is of heavier construction, and is driven by a 200 b.h.p. Eberman diesel engine and a four-speed gearbox which are mounted together on a driving bogie with 920 mm. (36 in.) wheels and a base of 3·35 m. (11 ft.). The engine has six cylinders and runs at 800 r.p.m.; it weighs 1,870 kg. (4,140 lb.), or 20·7 lb. per b.h.p., and the gearbox scales 1,380 kg. (3,050 lb.). The overall length is 20 m. (65 ft. 9 in.), the width 2·9 m. (9 ft. 6 in.) and the pitch of the bogies 14·2 m. (46 ft. 7 in.); the tare weight is approximately 40 tons, and mail, luggage, and lavatory accommodation is provided. The interior decoration is similar to the car described above, but consequent upon the space devoted to luggage and mails there are only 68 seats. Both cars are lighted electrically.

Four-wheeled Cars

The remaining diesel vehicle now in actual service on the Polish State Railways is carried on two axles and is of light construction throughout, the tare weight being 13·75 metric tons for a seating capacity of 50—all third class. The 100 b.h.p. Saurer engine and Mylius four-speed gearbox are placed beneath the floor, and are virtually duplicate with one of the sets on the first double-bogie car. Welding has been used almost exclusively in the construction of the underframe and body framing. Each wheel is fitted with two brake blocks which can be actuated either by the Westinghouse or hand screw brakes. The interior arrangement includes lavatory accommodation, and is generally similar to that of the larger vehicles, but the heating is carried out by passing air round the engine silencer and leading it through four ducts placed below the seats. The wheels are 900 mm. (35·5 in.) diameter spread over a base of 6·2 m. (20 ft. 4 in.), and the car extends over a length of 11·2 m. (36 ft. 9 in.). This railcar can be run in both directions and is capable of hauling a light trailer.

Diesel Progress in Australia

TWENTY years ago double-bogie designs of Bo-Bo and Co-Co diesel-electric locomotives were prepared by R. & W. Hawthorn-Leslie & Co. Ltd. for intended use on the Trans-Australian Railway, but the war caused the project to be shelved.

The honour of setting to work the first Australian diesel railcar belongs to the South Australian Government Railways, which organisation introduced a double-bogie vehicle on the Adelaide suburban lines a short time ago. The diesel engine is of the Gardner 85 b.h.p. type and the car itself was converted at the railway's Islington workshops from one of the older Type 55 petrol-engined railcars. At the present time one of the broad-gauge petrol cars with a 175 b.h.p. Winton engine is being converted into a diesel unit by the installation of a 200 b.h.p. high-speed heavy-oil engine.

As we noted in THE RAILWAY GAZETTE for October 26, the New South Wales Government Railways has recently placed an order in this country for ten 360 b.h.p. oil engines and hydraulic drives for installation in diesel trains with a maximum speed of 80 m.p.h., the mechanical portions for which will be built in Australia.

Finally, the Queensland Government Railways has taken delivery of an A.E.C. six-cylinder 130 b.h.p. high-speed engine which will be installed in the chassis of an old petrol railcar.

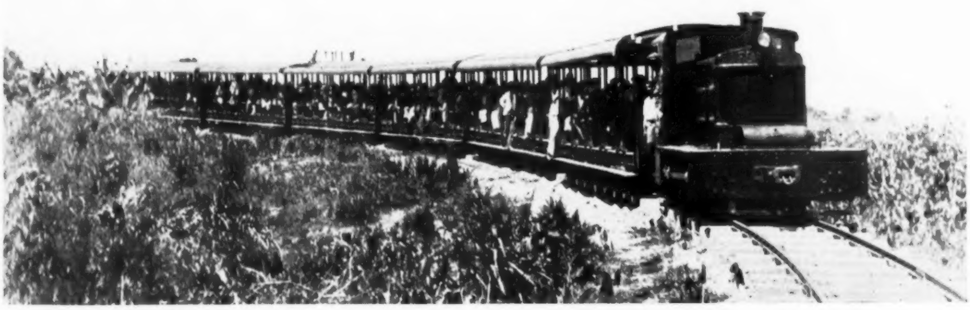
NOTES AND NEWS

Another Manchurian Diesel.—In addition to the diesel cars for local traffic which are to be set to work next year, the South Manchuria Railway is considering the possibilities of articulated high-speed diesel trains compounded of the virtues of various European and North American units. By the use of such trains, it is hoped to reduce the time between Dairen and Hsinking, the Manchukuo capital, to six hours, equivalent to 72 m.p.h.

South American Diesel Interest.—The Central Argentine Railway is understood to be seriously considering the adoption of diesel railcars, and the Chief Mechanical Engineer, Mr. W. P. Deakin, recently visited Europe to investigate the design and performance of various types of diesel railcars and locomotives.

bring about a substantial reduction in working costs. There are already two Armstrong-Whitworth diesel units under trial, and two further cars of a different type are due for delivery next year.

Entre Rios Goes Diesel.—The Birmingham Railway Carriage & Wagon Co. Ltd. has received an order from the Entre Rios Railways for 11 diesel-mechanical railcars of approximately 260 b.h.p. each. The cars will be of the double-bogie type with separate engines, one driving each bogie. The Gardner 5L3 heavy-oil engines will drive through a Vulcan-Sinclair hydraulic coupling and a Wilson preselective epicyclic gear box. The specification provides for an all-metal streamlined body with driving controls at each end, a first-class saloon seating 18 passengers, and a second-class seating 36 passengers, a buffet accessible to each saloon, separate lavatories, luggage and mail compartments. J. Stone & Co.'s lighting, heating and ventilation systems, and Airvac roof ventilators will be employed. J. W. Roberts asbestos is to be used for insulation, and Lockheed hydraulic brakes will be used. The car body will measure 68 ft. 6 in. overall, and the track gauge is 4 ft. 8½ in.



Six-coupled Fowler diesel-mechanical locomotive at work on a sugar plantation in British Guiana

Diesels in Sugar Plantations.—On this page we illustrate a 52 b.h.p. diesel-mechanical locomotive built by John Fowler (Leeds) Limited, hauling a labour train on a sugar plantation in Demerara. The passenger traffic on this line, belonging to Enmore Estates Limited, consists of two outward trains in the morning and two inward trains in the evening, which run a distance of 5½ miles. The bogies and underframes of the cars are also of Fowler manufacture, and the passenger vehicles seat about 50 persons each.

More Italian Railcars.—In addition to the 43 diesel mechanical railcars with 130 b.h.p. A.E.C. engines ordered some time ago by the Italian State Railways, another four vehicles of the same type are to be built, and, like their predecessors, are to be fitted with Vulcan-Sinclair traction type hydraulic couplings.

Shunting Locomotives for Holland.—Another 21 diesel-electric loco-tractors of the type illustrated and described in the issue of this Supplement for September 7 have been ordered from Werkspoor N.V., by the Netherlands Railways. The 85 b.h.p. diesel engine will be of the Ganz type built by Stork Bros., of Hengelo, and the locomotive weight will be 21 tons.

Buenos Ayres Western Diesels.—Following his remarks on diesel traction to the shareholders of the Buenos Ayres Great Southern Railways (dealt with in another part of this issue), Sir Follett Holt referred in encouraging terms to the future of diesel vehicles at the annual meeting of the Buenos Ayres Western Railway, and said that the Board was looking to diesel traction to

Chanson d'Hiver.—

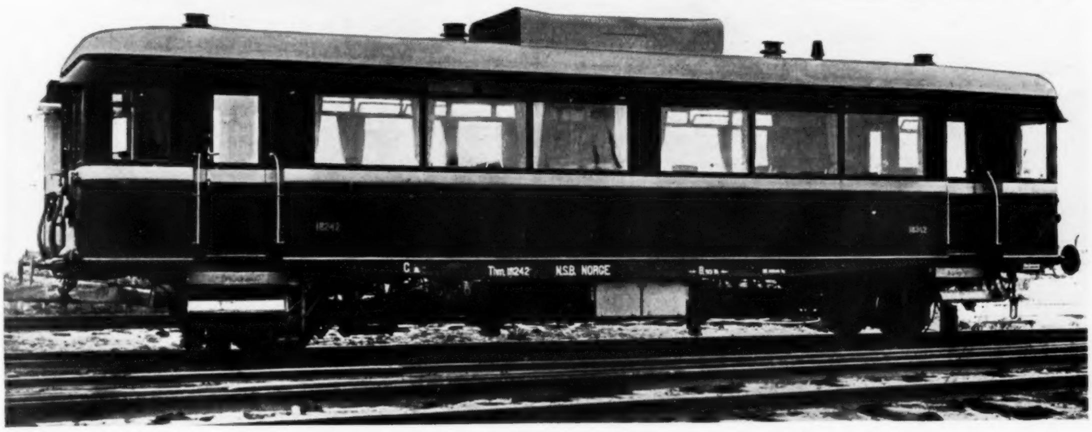
" Mon Dieu " dit l'Ingénieur en Chef
" C'est magnifique, ce Burlington Zeph "
Et presque tout de suite
Il en bâtit dix-huit.
[Ce récit est charmant, mais bref.—ED.]

High Powered American Diesel Locomotive.—It is understood that the Atchison, Topeka and Santa Fe Railways has placed an order with General Motors Corporation for one 3,600 b.h.p. diesel-electric locomotive for pulling the express, The Chief, which runs between Chicago and Los Angeles. The motive power will consist of four 900 b.h.p. two-stroke Winton engines.

German Express Diesel Lines.—During the course of 1935 the German State Railway is to inaugurate high-speed diesel services with trains of the Flying Hamburger type on the following routes: Berlin-Cologne, Hamburg-Cologne, Berlin-Munich, Nuremberg-Stuttgart, Berlin-Leipzig, Berlin-Dresden, Berlin-Breslau-Beuthen, and Berlin-Konigsberg. The last-named service will run through the Polish corridor.

THE FARTHEST NORTH IN DIESELS

Norwegian railcar for heavily-graded line has high power per unit of weight



Norwegian 270 b.h.p. diesel-mechanical railcar with eight-speed gearbox

IN May last the Norwegian State Railways put into service their first diesel railcar, and this is now operating in the Trondhjem district. Built by A/S Strommens Verksted to the designs of Mr. H. Olaf Storsand, the Rolling Stock Superintendent, the car is of the two-axle type with the exceptionally long wheelbase of 8.5 m. (27 ft. 10 in.). There is a driving cabin at each end of the car, and the passenger accommodation is arranged in two compartments, smoking and non-smoking, access to which is gained by four side doors. To facilitate communication with the trailers, one or two of which can be hauled according to the gradients, end doors are also fitted. The underframe and body are built as an integral unit; the body sides have external panel plates of aluminium, and the interior, including the ceiling, is lined in Gaboon plywood filleted with teak.

Leather-upholstered reversible seats are fitted in both compartments, and lavatory accommodation is provided. In order to get in the maximum number of seats, the power equipment is placed beneath the underframe, but the floor slopes slightly upwards from each end towards the centre so as to clear the top of the engine. Normally, the car is heated by circulating the cooling water, but in winter a small coke stove below the floor is kept going, and this warms the engines, cooling water, and car. Braking is on the vacuum and hand systems, which operate shoes on drums secured to the wheel centres. The car tares 18·5 tons, and as the total engine output is 270 b.h.p., the vehicle has the remarkably high power-weight ratio (considering that it is not a high-speed unit), of 14·6 b.h.p. per ton of tare, or 5·25 b.h.p. per ton of gross weight including 30 tons of trailers.

Propulsive force is provided by two 135 b.h.p. Mercedes-Benz engines of the type illustrated by a cross-sectional arrangement in the issue of this Supplement for March 23 last. The six cylinders are 125 mm. by 170 mm. (4·95 in. by 6·7 in.) and rated output is developed at 1,700 r.p.m. The engines are mounted on rubber blocks attached to a sub-frame which is itself insulated by rubber from the main underframe. The constant-mesh gearboxes have no less than eight speeds, all of which except the last two have a free wheel. On the top (or overspeed) step the car speed is 88 km.p.h. (55 m.p.h.), but the seventh step is normal direct drive and gives a speed of 70 km.p.h. (43·5 m.p.h.). Gear-changing is effected pneumatically.

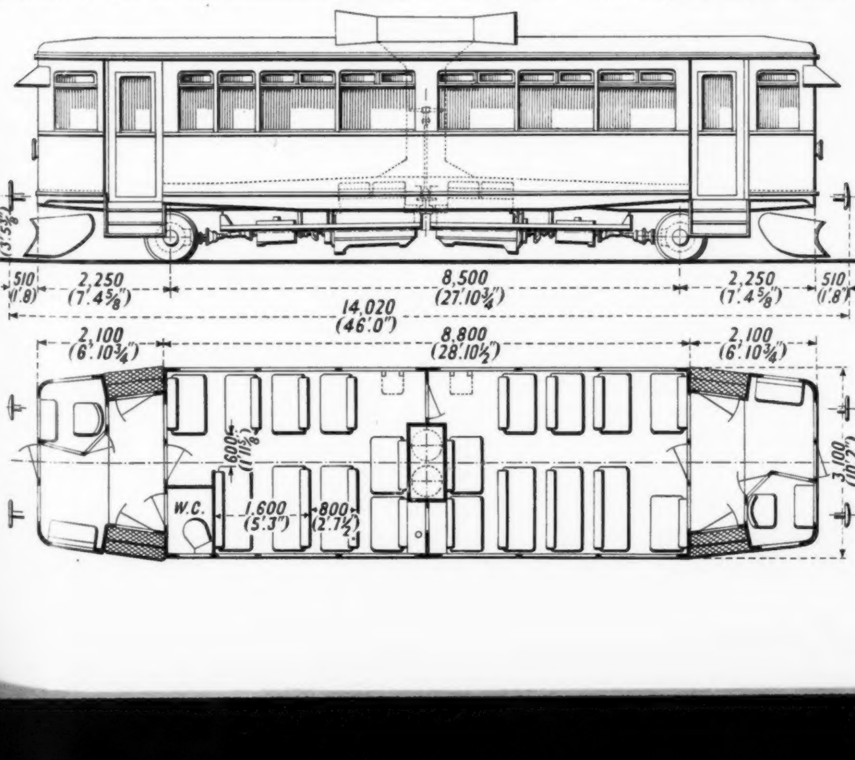


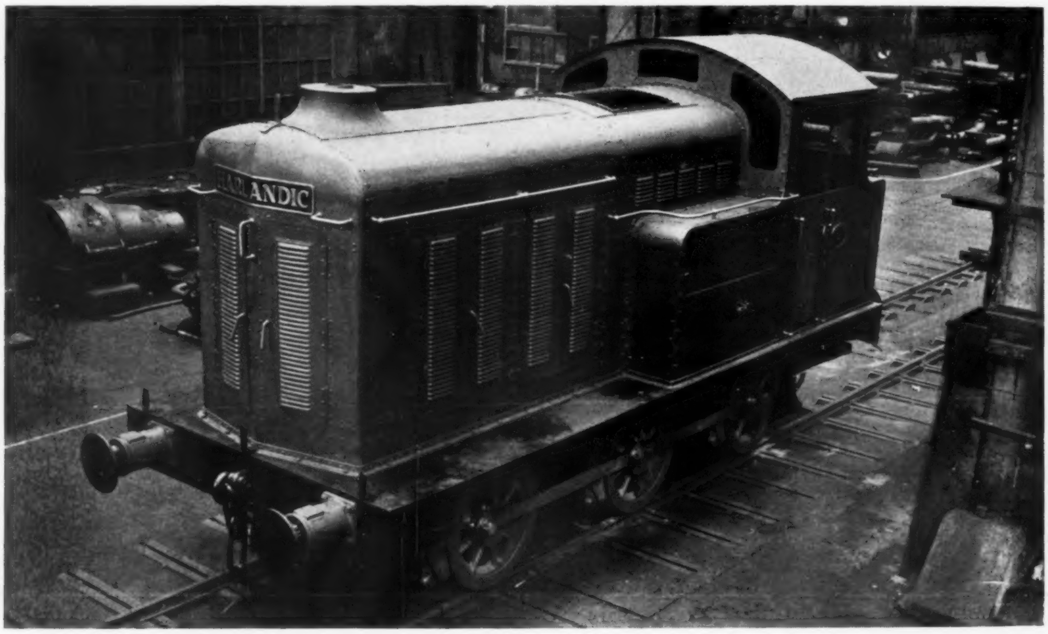
Diagram of double-engined diesel-mechanical railcar on Norwegian State Railways, showing seating accommodation and arrangement of radiator fan ducts in partition dividing the smoking from the non-smoking compartment

SEVENTH L.M.S.R. DIESEL SHUNTER

A SIX-COUPLED diesel shunting locomotive destined for service on the L.M.S.R. has recently been completed at the Belfast works of Harland & Wolff Ltd. and is to be numbered 7057 in the railway company's list. It is of the six-wheel, rigid frame type, and as all three axles are coupled, the total weight of approximately 27½ tons is available for adhesion. The locomotive has a tractive effort at starting of 11,200 lb. and has been designed for driving by one man. The controls are duplicated for easy manipulation from either side of the cab, which has windows giving a clear view of the approaching and traversed track.

The diesel engine itself is of the Harland-B. & W. two-stroke type, developing 175 b.h.p. at 1,100 r.p.m., and is fitted with an overspeed governor cutting out at 1,250 r.p.m. Normally the revolutions are about 850 r.p.m., but the higher speed may be used when accelerating. The engine is started by compressed air, stored in reservoirs at a pressure of 375 lb. per sq. in., and charged by a two-stage compressor directly driven from the main engine crankshaft. An auxiliary compressor, driven by a 2½ b.h.p. petrol-paraffin engine, is also provided, and the brakes are applied by air at a pressure of 100 lb. per sq. in. from this auxiliary unit; the whistle is worked off the low-pressure stage of the compressor. Each cylinder contains a glow plug, heated electrically from the accumulators, which facilitates starting up from cold.

Airless injection is used, and the engine is provided with a rotary scavenging blower, gear-driven from the crankshaft. A uniflow system of scavenging enables the engine to develop a mean effective pressure approximately equal to that of a four-stroke unit, with the added advantage of an even turning movement, given by one impulse per cylinder per revolution. Each cylinder has a separate pump supplying fuel under pressure to the automatically-operated atomisers in the cylinder heads. Not only is a silencer provided for the exhaust, but one is also fitted to prevent noise at the scavenging air inlet. The engine is installed in a large bonnet with sheet metal sides, and the parts are readily accessible through ample inspection doors. Power is transmitted through a Vulcan-Sinclair hydraulic coupling to a two-speed gearbox, and is taken thence by a cardan shaft to the front axle of the locomotive. This cardan shaft has the normal universal joints, which allow vertical motion of the axle in relation to the frame. When the locomotive is at rest dog clutches engage the reverse gear. The fuel tanks have a capacity of 105 gal. and the water tank 55 gal.



The latest L.M.S.R. diesel-mechanical shunting locomotive

Large American Diesel Order

The Illinois Central Railroad has just placed orders for diesel vehicles valued at $1,600,000, probably the largest purchase of diesel units ever made at one time in America. A sum of $400,000 is to be expended on a five-car streamlined articulated diesel-electric train for express service between Chicago and St. Louis. It is to be built by the Pullman Car & Manufacturing Corporation, and will be powered by a 1,200 b.h.p. two-stroke Winton engine. This train, which will have accommodation for 150 passengers with baggage and mail, will weigh approximately 250 tons gross, and will replace two six-car steam trains with a weight of 600 tons each, including the locomotive.

The remaining $1,200,000 will be expended on three transfer and eight shunting locomotives. The former will be powered by Busch-Sulzer, Winton, and Ingersoll-Rand engines, and the first-named will have an output of 2,000 b.h.p. in one unit, the remaining two being of 1,800 b.h.p. The shunting locomotives will be of 600 b.h.p.

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